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Forest Health Protection
Pacific Southwest Region

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To: District Ranger, Feather River Ranger District, Plumas National Forest

Subject: Insect and Disease Evaluation of the Paradise Lake Silvicultural Certification Stand within the Concow Fuel Reduction Project (FHP Report NE11-07)

At the request of Judy Welles, Silviculturist, Feather River Ranger District, Danny Cluck and Amanda Grady, Forest Health Protection (FHP) Entomologists, conducted a field evaluation of her silvicultural certification stand near Paradise Lake as well as other units within the Concow Fuel Reduction Project on February 4, 2011. The objectives were to evaluate the current forest health conditions within the stand, discuss what influence these conditions would have on stand management objectives and provide recommendations as appropriate. Judy accompanied us to the field.

Site information

The Concow Fuels Reduction Project (CFRP) consists of Forest Service owned parcels between Paradise Lake and Concow Reservoir (39° 48.5644"N and 121° 32.9000"W). Elevations range from 2,500 to 3,300 feet with annual precipitation between 60 and 70 inches. Forest cover varies with elevation and aspect and between parcels. Most stands are comprised of Sierra Nevada mixed conifer and hardwood with differing percentages of the following species; ponderosa pine (*Pinus ponderosa*), sugar pine (*Pinus lambertiana*), Douglas-fir (*Psuedotsuga menziesii*), incense cedar (*Calocedrus decurrens*), white fir (*Abies concolor*), Jeffrey pine (*Pinus jeffreyi*), black oak (*Quercus kelloggii*) and tanoak (*Lithocarpus densiflorus*) (Figure 1). The 2008 Concow Fire burned the southeastern half of the project area resulting in high numbers of fire-killed trees.

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Management objectives for the CFRP are to create defensible fuel profile zones (DFPZs) along road corridors and next to communities by removing surface and ladder fueldds, reducing stocking levels and improving desirable species composition to create more resilient stand conditions. Areas within the Concow Fire will focus on dead tree removal, course woody fuel reduction and reforestation.

Figure 1. Dense mixed conifer and hardwood stand at Paradise Lake.

Forest insect and disease conditions

Paradise Lake

Insect and/or disease caused tree mortality is occurring at a very low level in stands near Paradise Lake. Only a few disease agents were detected, none of which are causing any significant level of injury or mortality.

- Western gall rust (*Endocronartium harknessii*) was observed on a single ponderosa pine.
- Red ring rot (*Phellinus pini*) was found on the bole of a single Douglas-fir near the edge of the lake (this is the general area of the campground where several large *P. pini* infected Douglas-fir were evaluated in 2004 – refer to FHP Report NE04-04).
- Diplodia blight (*Sphaeropsis sapinea*) is infecting a few ponderosa pines.
- White pine blister rust (*Cronartium ribicola*) is causing branch mortality and top-kill in some sugar pines.

Although bark beetle caused mortality was not observed during this visit, western pine beetle (*Dendroctonus brevicomis*) was observed during a visit in 2004 (FHP Report NE04-04) causing mortality of large diameter ponderosa pines.

Concow Fire Area

Most of the delayed mortality of fire-injured conifers has occurred, especially in the smaller diameter size classes. A few recently fading large diameter ponderosa pines were observed that appeared to have endured basal fire-injuries but no significant crown kill.

Figure 2. Fire-killed snags and downed logs. Logs in foreground were trees cut to protect power lines.

Many fire-killed snags are beginning to fail, snapping off at the base, due to high levels of sapwood decay. This is resulting in

heavy surface fuel loads in many areas as well as very hazardous conditions (Figure 2).

Current bark and woodboring beetle activity is limited to fire-injured trees and occurring at low levels.

Considerations for thinning at Paradise Lake (including silvicultural certification stand)

Prescriptions that meet the requirements of a DFPZ should also be consistent with past direction from the Regional Forester to thin to "ensure that density does not exceed an upper limit (for example: 90% of normal basal area, or 60% of maximum stand density index)" and to "design thinnings to ensure that this level will not be reached again for at least 20 years after thinning." (Regional Forester letter, "Conifer Forest Density Management for Multiple Objectives", July 14, 2004). Reducing stocking levels to this range should effectively reduce inter-tree competition for limited water and nutrients and reduce the risk of insect and disease caused mortality.

The proposed treatment alternative aims to reduce stocking through a general thinning combined with radial release of large conifers (three largest per acre) and black oak (up to five >6" dbh per acre). The target basal area will be determined mostly by the 40% canopy closure requirement but should still be low enough to reduce the risk of bark beetle caused mortality.

Ponderosa pine growing in this area is at a much higher risk to bark beetle caused mortality than the other conifers due to its abundance within the stand. There is also a history of western pine beetle activity both at Paradise Lake and in similar low elevation west side Sierra Nevada forests during periods of drought. Therefore, ponderosa pine should be given special consideration when planning thinning treatments to reduce its susceptibility to successful western pine beetle attacks. Risk could be decreased by reducing density to lower levels in ponderosa pine dominated pockets than what is appropriate for surrounding mixed conifer stands and/or by removing more ponderosa pines from these pockets in favor of retaining other tree species to increase diversity. Sufficiently lowering the basal area in pine dominated pockets will likely reduce their canopy cover to below required thresholds. However, more basal area, and higher canopy cover, could be retained in adjacent mixed conifer areas in order to maintain an average of 40% canopy cover throughout the entire stand.

Lowering density in these pockets will not only increase the health and vigor of individual trees but may serve to change the microclimate, creating a less favorable environment for bark beetle pheromone communication. Opening up the canopy creates convection currents and air turbulence through increases in soil temperature as well as increasing wind speed (Bartos and Amman 1989, Amman and Logan 1998). This prevents bark beetle pheromone plumes from concentrating under the canopy and remaining in close proximity to individual trees or groups of trees.

It is recommended that a registered borate compound be applied to all freshly cut pine and cedar stumps >14" dbh to reduce the chance of creating new infection centers of *Heterobasidion irregulare* (formerly 'P'-type annosus root disease) within treatment units. *H. irregulare* is not typically a problem in pines on the west side of the Plumas National Forest but the large

diameter of many of the trees proposed for removal increases the chance of successful inoculation of freshly cut stumps from airborne *H. irregulare* spores. Because this is a highly utilized area by the local public, applying a borate compound to stumps within treatment units may reduce the number of future root diseased trees that could pose a hazard to people. Any recreation sites that include tree removal will require the treatment of all conifer stumps greater than 3" in diameter (FSM R5 Supplement 2300-92-1 modified by FSH R5 Supplement 3409.11-2010-1).

Special consideration needs to be given to sugar pine within the project area. Sugar pine should be retained as much as possible during any thinning operation in order to preserve genetic diversity, especially white pine blister rust (*Cronartium ribicola*) resistant individuals. White pine blister rust, a non-native pathogen, has continued to weaken and kill this species over most of its range since its introduction into the Pacific Northwest in 1910. If any rust resistant sugar pines are located within the project boundary, they should have all competing vegetation and fuels removed from their immediate area, including the removal of larger competing trees reducing crown exposure and facilitating squirrel access to cones. In addition, planting openings created by harvest or mastication activity with rust resistant stock would help insure this species persists in the area. Any tree planting within the Paradise Lake area will need to plan for severe competition from tanoak.

Considerations for prescribed fire at Paradise Lake

If prescribed fire is used as a follow-up treatment to stand thinning, unacceptable levels of large diameter pine mortality may occur depending on management objectives. This mortality most often occurs as a direct result of cambium or crown injury to individual trees during the fire. Mature Jeffrey, ponderosa and especially sugar pines (Figure 3) are susceptible to mortality during prescribed burns because of the deep duff and litter that has accumulated at their base in the absence of fire. These duff mounds typically burn at a slow rate, while maintaining lethal temperatures, causing severe cambium injury. To protect individual large diameter pine from lethal cambium injury, raking the duff away from the bases of these trees before burning (within 24" of the bole and down to mineral soil) is highly recommended.

Figure 3. Deep duff and litter around the base of two sugar pine.

Previous FHP evaluations have documented high levels of basal fire-injury to conifers when masticated units were subsequently burned as soon as chips were dry. The depth and proximity of masticated brush and small tree material to residual trees determined the level of basal injury and subsequent mortality. Since there will likely be large amounts of tanoak chips after mastication in some areas, it may be necessary to rake chips away from the bases of trees that are

to be to maintained as residuals or allow enough time between mastication and the underburn to allow the chipped material to decompose enough to alter the flammability and heat intensity.

Fire-injured and fire-killed trees within the Concow Fire area

Most of the expected fire-related tree mortality within the Concow Fire has already occurred. Although more trees will likely succumb to a combination of fire-injury and bark beetle attacks over the next several years, FHP monitoring of recent fires throughout the Sierra Nevada shows that ~80% of the mortality occurs within two years post-fire and roughly 90% occurs by the end of the third post-fire year. Furthermore, significant mortality is not expected in adjacent unburned areas as a result of the current bark beetle activity within the fire perimeter.

Figure 4. Fire-killed snags next to a main road within the Concow Fire.

The main concern with respect to fire-injured and fire-killed trees is that they pose a hazard to people and property when they are located along roads and around landings. They also pose a threat to employees that will be trying to implement restoration projects in burned areas. Fire-killed snags are already beginning to fail and it is expected that the rate of failure will increase over the next 5 years. It is highly recommended that dead trees and severely fire-injured trees (Appendix A) be removed from all roadsides as soon as possible (Figure 4) and that special consideration be given to these types of trees when employees begin restoration activities such as fuel reduction, site prep and planting. Snags that pose a threat to workers should be removed or have a no-entry zone established to keep people out of the potential failure zone.

If you have any questions regarding this report and/or need additional information please contact me at 530-252-6431 or email dcluck@fs.fed.us.

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Appendix A – Recommendations for identifying fire-injured tree hazards.

These recommendations are intended to be a supplement to the Plumas NF hazard tree guidelines which indentify various types of defect and failure potential. All dead trees with a target should be marked for removal.

If trees that are fire-injured do not first meet the Plumas NF hazard tree criteria, evaluate their failure potential based on the following criteria:

- Mark trees with evidence of significant bark and/or wood boring beetle activity if any combination of the following are present over at least 1/3 of the tree circumference:
    - Pitch tubes with pink or reddish boring dust
    - Pouch fungus conks and/or current woodpecker activity (holes into the sapwood and/or bark flaking). Excludes injury caused by sapsucker feeding
    - Boring dust or frass in bark crevices, webbing along the bole, or at the base of the tree
        - Excludes basal attacks by the red turpentine beetle (large pitch tubes associated with coarse boring dust generally in the lower 2-3 feet of the bole or woodpecker activity restricted to this area)
        - Do not mark if only associated with wounds or old fire scars
- Deep Charring
    - Mark all white fir and red fir that have deep charring (see bark char definitions below) over 1/3 of the bole circumference
        - More common on trees next to high burn severity patches, on trees with charring extending high on the bole, and on trees that had downed logs or other debris next to the bole
    - Mark all sugar pine, ponderosa pine, incense cedar, and Douglas-fir that have deep charring over 1/2 of the bole circumference

Sample cambium on deep charred trees as needed to confirm that the cambium is dead when associated with deep charring. If you find the deep charring is not always associated with dead cambium, these guidelines may need to be modified.

Bark Char Definitions

Unburned or light charring: light charring has some blackened areas on the bark but unburned portions remain. These unburned portions are generally found in the bark fissures.

Moderate charring: with moderate charring, all bark is blackened but the bark characteristics remain.

Deep charring: with deep charring, all the bark is blackened and bark characteristics are no longer discernible. Areas of deep char will often have thinner bark than light or moderately charred areas of the bole.

Insect and Disease Information

White pine blister rust

White pine blister rust is caused by Cronartium ribicola an obligate parasite that attacks 5-needled pines and several species of Ribes spp. The fungus needs the two alternate hosts to survive, spending part of its life on 5-needled pines and the other on Ribes spp. The disease occurs throughout the range of sugar pine to the southern Sierra Nevada, but has not been reported further south. Infection of pines results in cankers on branches and main stems, branch mortality, top kill, and tree mortality.

Spores (aeciospores) produced by the fungus in the spring on pine bole or branch cankers are wind-disseminated to Ribes spp. where they infect the leaves. Spores (urediospores) produced in orange pustules on the underside of the leaves reinfect other Ribes spp. throughout the summer, resulting in an intensification of the rust. A telial spore stage forms on Ribes spp. leaves in the fall. Teliospores germinate in place to produce spores (sporida) which are wind-disseminated to pines and infect current year needles. Following infection, the fungus grows from the needle into the branch and forms a canker. After 2 or 3 years, spores are produced on the cankers and are spread to Ribes spp. to continue the cycle. Although blister rust may spread hundreds of miles from pines to Ribes spp., its spread from Ribes spp. back to pines is usually limited to a few hundred feet.

Branch cankers continue to enlarge as the fungus invades additional tissues and moves toward the bole. Branch cankers within 24 inches of the bole will eventually form bole cankers. Bole cankers result in girdling and death of the tree above the canker. Cankers that have margins more than 24 inches from the main bole are unlikely to reach the bole and only branch flagging will result.

Red Ring Rot

Red ring rot, also called white pocket rot, is caused by a wood decay fungus, *Phellinus* (*Fomes*) *pini*, that attacks Douglas-firs, pines, true firs, hemlock, and rarely incense-cedar. It occurs throughout the coniferous forests of the world, and is the single most damaging heart rot organism in the West.

Red ring rot attacks young-growth as well as old-growth trees. It usually infects through branch stubs, and rarely through open wounds. Thus, this fungus may cause serious heart rot problems in managed stands of the future.

The perennial, woody fruiting bodies or conks that arise from the branch stubs or knots of living trees are the best indicators of decay. Sometimes only punky knots bearing the inner portion of the fruiting body remain on the stem. These punky knots may later be overgrown by new wood, becoming swollen knots that are the only symptom of decay. When conks or swollen knots are present, assume that advanced decay extends about 3-5 feet above and 5-7 feet below the indicator. If conks or swollen knots are visible along much of the stem, heart rot will be extensive.

Western Pine Beetle

Hosts: Ponderosa pine and Coulter pine

Distribution in California: Throughout the range of suitable host trees.

Identification: Smallest of the western *Dendroctonus* species, this black cylindrical beetle is about the size of a grain of rice (4 mm long). Egg galleries are winding and packed with frass. Larval galleries lead away from the main gallery for short distances before turning into the outer bark. Small, reddish pitch tubes (sometimes fairly obscure) are signs of successful attack. Attacked trees often exhibit woodpecker feeding with only portions of the outer bark removed. Sapwood of infested trees usually shows evidence of the characteristic bluestain associated with fungi introduced by attacking beetles.

Effects: Successful attacks result in death of the host tree. Groups of trees are sometimes killed, especially when growing under crowded conditions. Since larger trees are generally preferred, the western pine beetle can dramatically alter the character of a forest that comes under attack.

Ecological Role: The western pine beetle serves as a key mortality agent for ponderosa pines weakened by the effects of old age, drought, smog, diseases, or competition with other trees. Stand structure can be altered and gaps can be created in the stand as the bark beetles kill larger trees, either singly or in groups. In those instances where ponderosa pine occurs in mixed stands with firs, the western pine beetle can accelerate the successional process by selectively removing the early seral species from the stand. Trees infested by the western pine beetle provide temporary food sources for woodpeckers and other insectivores. Infestation by western pine beetle sets the stage for other agents, such as wood borers and decay fungi that are involved in the recycling of nutrients back into the soil.

Life History: In the northern part of its range and at higher elevations, the western pine beetle completes two generations in one year, with adult beetles flying in early to mid June and mid to late August. In the southern part of its range and at lower elevations, the beetles produce three and sometimes four generations per year. Attacks may be as early as March and as late as November. Female beetles locate a suitable host and initiate attacks by burrowing through the bark. They release a pheromone that attracts other beetles and leads to mass attacks of the host tree and sometimes several trees in a group. Each female lays about 60 eggs in individual niches cut in the sides of the egg gallery. These eggs hatch in two weeks and young larvae feed initially in the phloem, later moving into the outer bark where most of their development takes place. After four larval stages, the insects turn into pupae and then adults.

Conducive Habitats: The western pine beetle breeds most commonly in trees of reduced vigor. While older, larger trees are generally preferred, younger trees can also be infested, especially when they occur in dense stands, are infected by pathogens, or are damaged by fire. During periods of drought, the western pine beetle will be particularly prominent and can overcome apparently healthy trees.

Similar Insects: Other bark beetles attacking ponderosa pine may be distinguished from western pine beetle by their egg gallery characteristics and adult appearance. Egg galleries of the mountain pine beetle are straight and vertical, and those of the engraver beetles possess a nuptial chamber with one to several tunnels radiating out from it. Engraver beetle egg galleries are free of frass. Ips adults display a pronounced concavity at the rear end of the elytra that possesses three to six spines on either side. The elytral declivity on *Dendroctonus* adults is rounded and does not possess any spines.

Management Strategies: The detrimental effects of western pine beetle can best be minimized by providing vigorous growing conditions for host trees. Stand densities below the “Upper

Management Zone" (Cochran 1992; Cochran et al 1994) will provide sufficient growing space for trees and will minimize potential habitat for the western pine beetle. *Dendroctonus* beetle group-kills cause a limiting Stand Density Index of 365 that differs little between stands on good and poor sites in California (Oliver 1995). In the past, "high-risk" trees (those most likely to be infested by the western pine beetle) were identified by various hazard rating systems (Keen 1936; Salman and Bongberg 1942; Smith et al. 1981) and removed. Short-term treatments are also available to protect individual, high value trees such as spraying insecticides on tree boles to prevent bark beetle attacks. Other short-term treatment options for individual trees are currently being evaluated such as the use of anti-aggregation pheromones and non-host angiosperm volatiles. Tree injection systems are being explored to treat trees with systemic insecticides.